(12) UK Patent Application (19) GB (11) 2 190 144 (13) A

(43) Application published 11 Nov 1987

(21) Application No 8710562

(22) Date of filing 5 May 1987

(30) Priority data
(31) 8610928 (32) 3 May 1986 (33) GB

(51) INT CL⁴
F03B 7/00

(52) Domestic classification (Edition I):
F1T H1E1
F1V 108 204 B

(56) Documents cited
GB 1563114 GB 1452483 EP 0104297
GB 1456128 GB 0189751

(58) Field of search
F1S
F1T
F1V
Selected US specifications from IPC sub-class F03B

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(54) Vaned water wheel

(57) A water wheel device comprises a drum (2) rotatable about a horizontal or vertical axis in a water flow. The drum is provided with a plurality of lengthwise extending pivotted vanes (12) moveable between an inoperative, retracted position in which they lie flush with the drum circumference and an operative position in which they project sequentially into the water flow as the drum rotates.

When the axis of rotation is horizontal, the drum may act as an undershot wheel or an overshot wheel. The vanes may overlap in their retracted position (Fig. 4 not shown) and stops may be provided to limit their pivotal travel. The wheel may be used to drive a pump or generator, details of mounting and water chanelling and guiding also being disclosed. (Figs. 6 to 8 not shown). The drum may be provided with end plates having a flywheel effect.

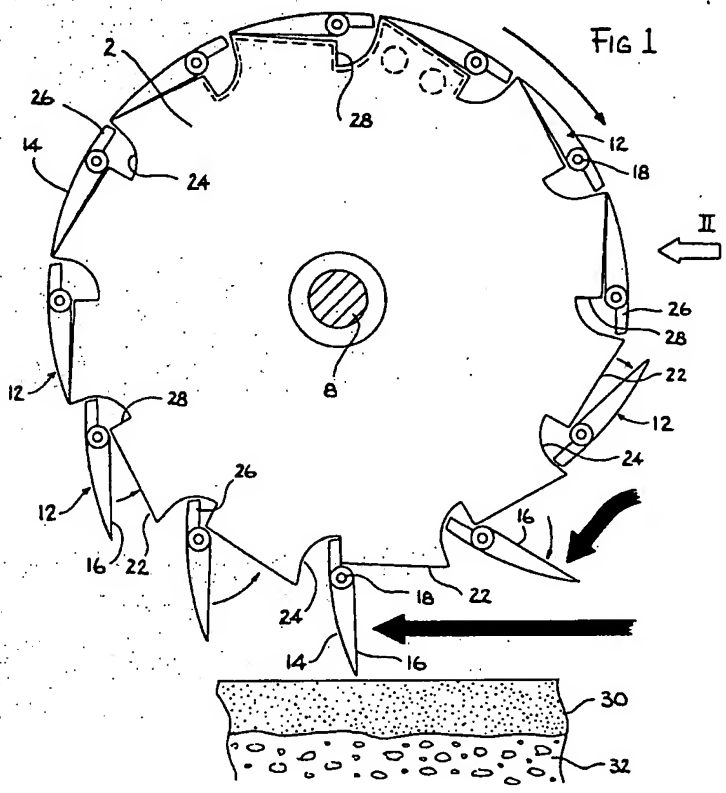

Fig 1

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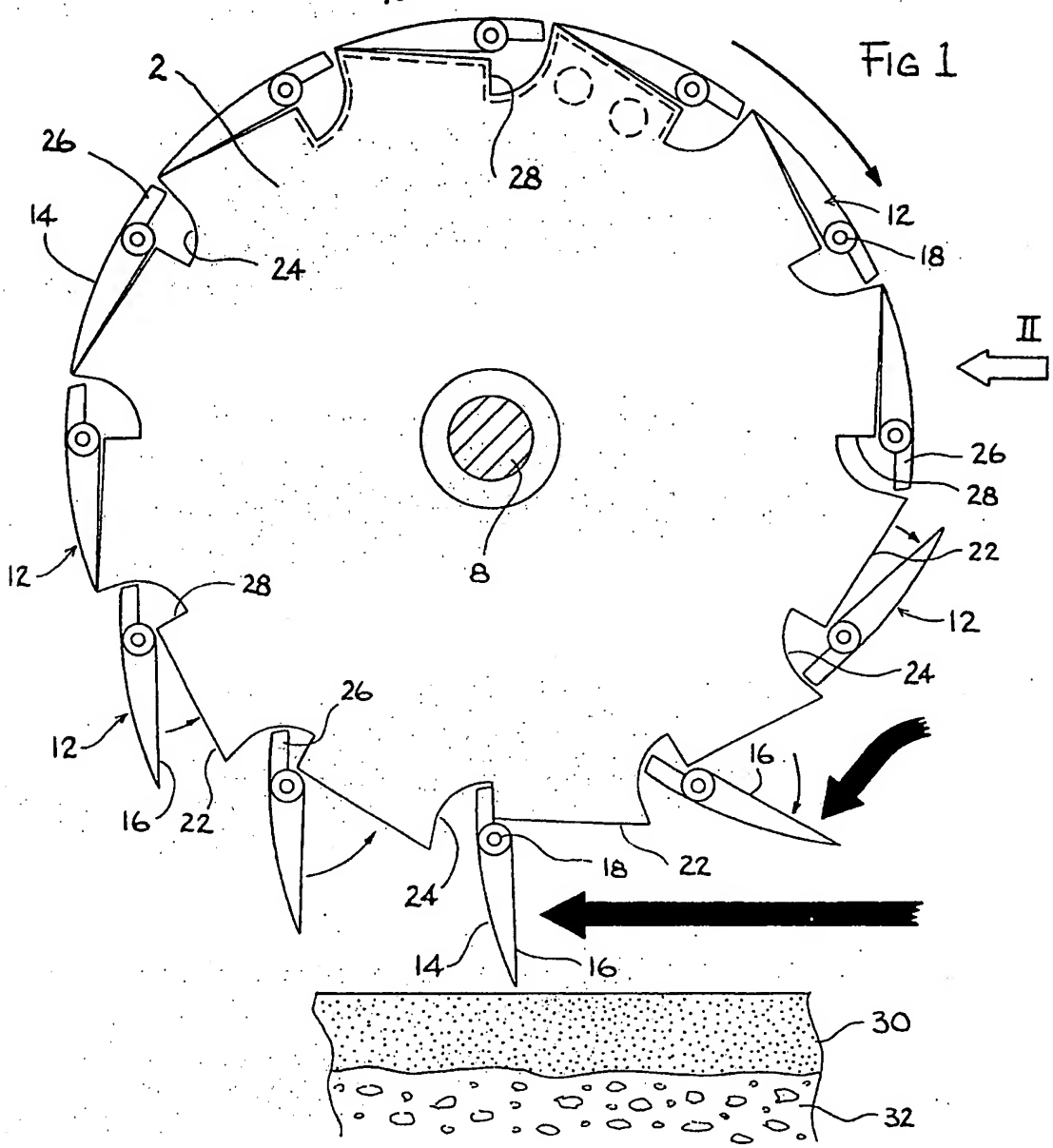
The drawings originally filed were informal and the print here reproduced is taken from a later filed formal copy.

FIG 1


2
26
14
24
28
12
18
II
26
28
22
12
24
16
18
22
24
14
16
30
32
12
28
12
26
16
22
8

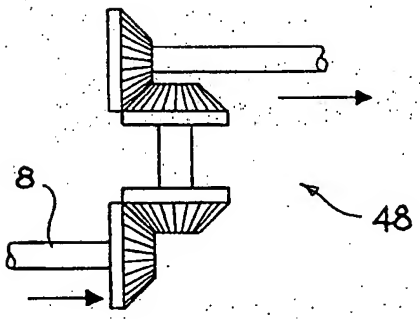

8
48

FIG. 7

FIG. 2

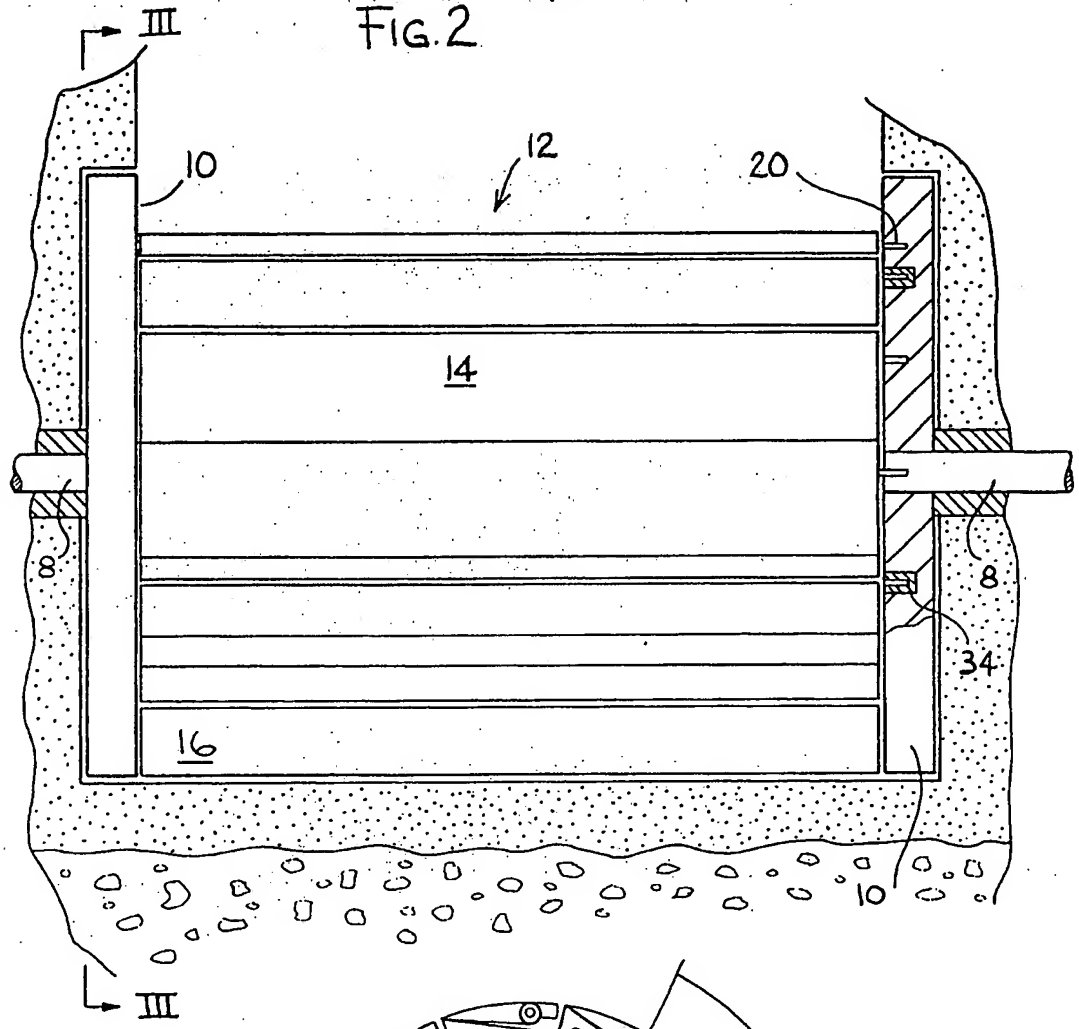
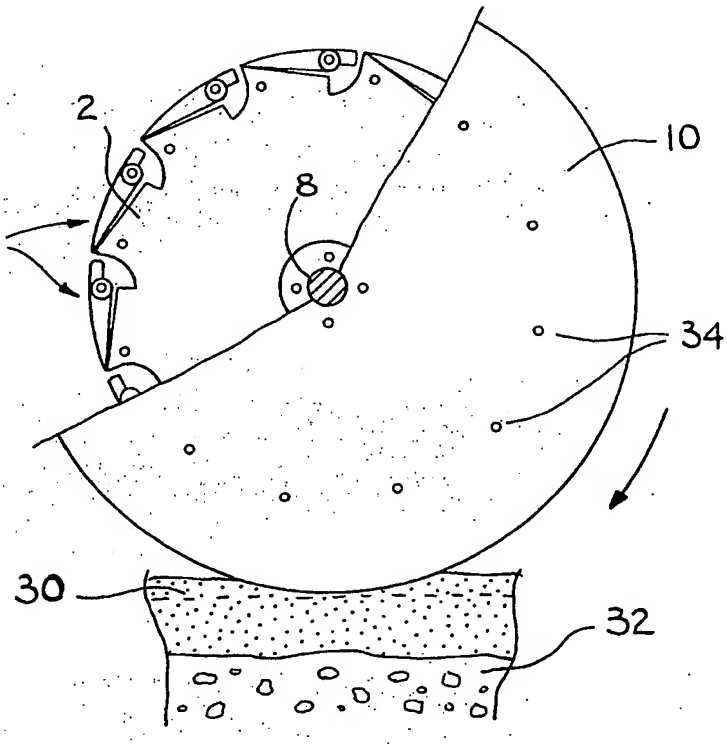


FIG. 3



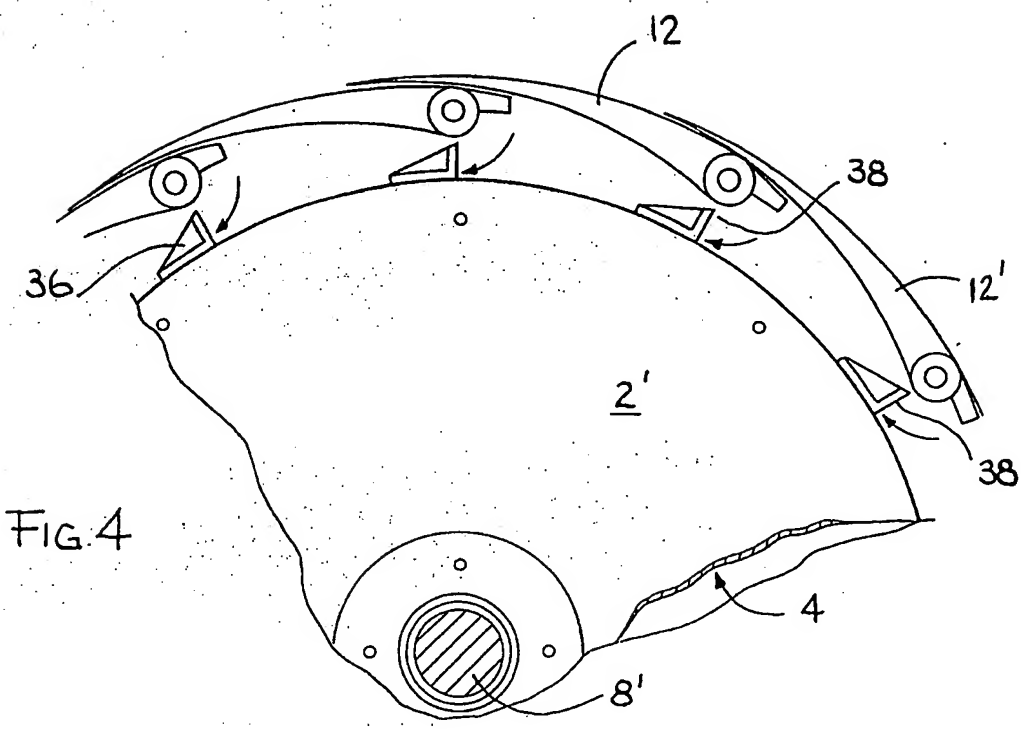


FIG.4

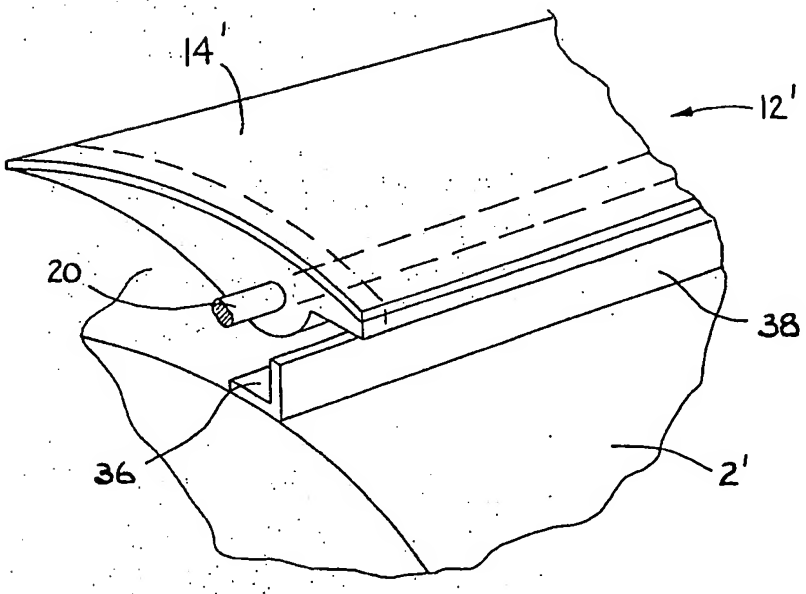


FIG.5

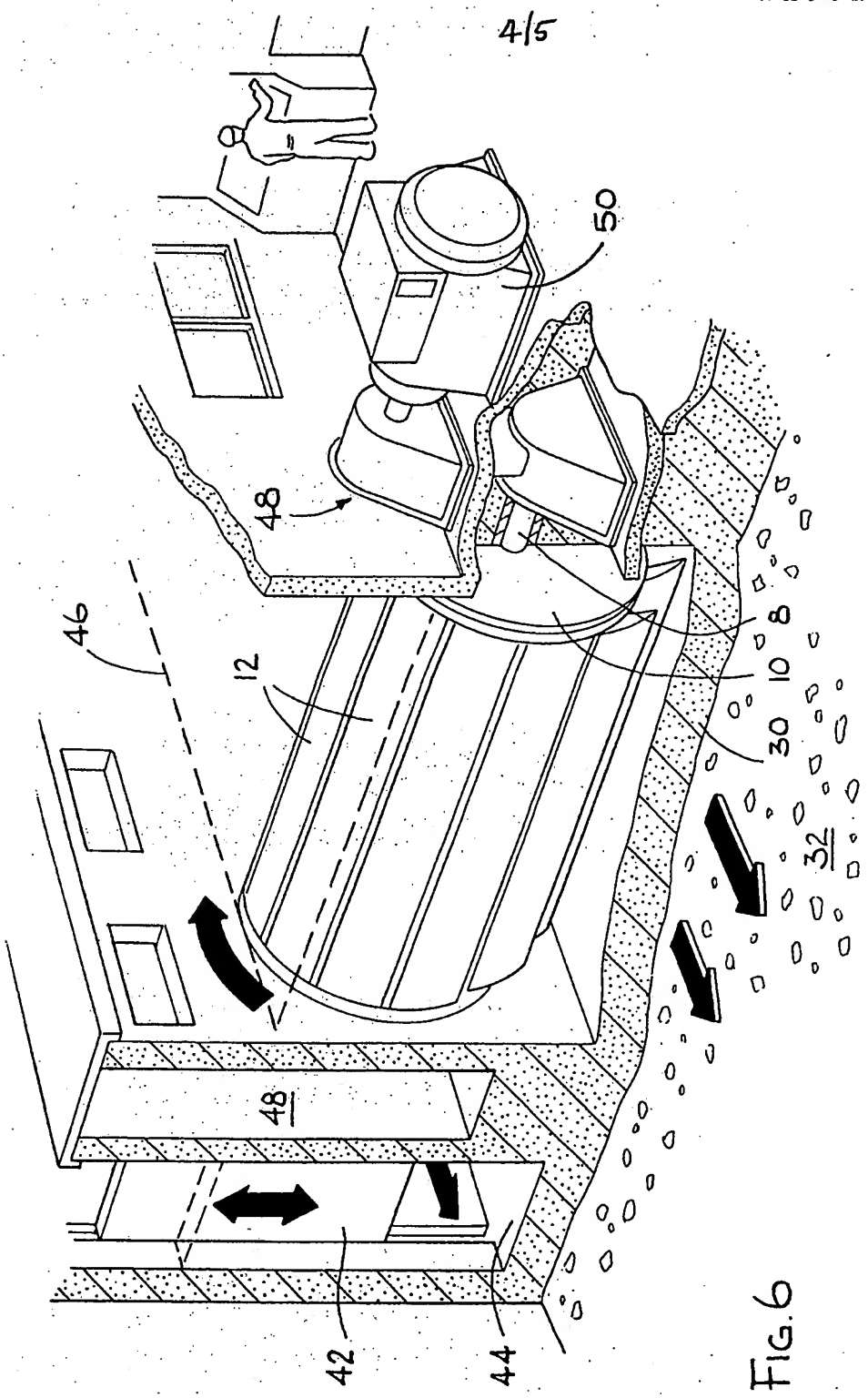


FIG. 6

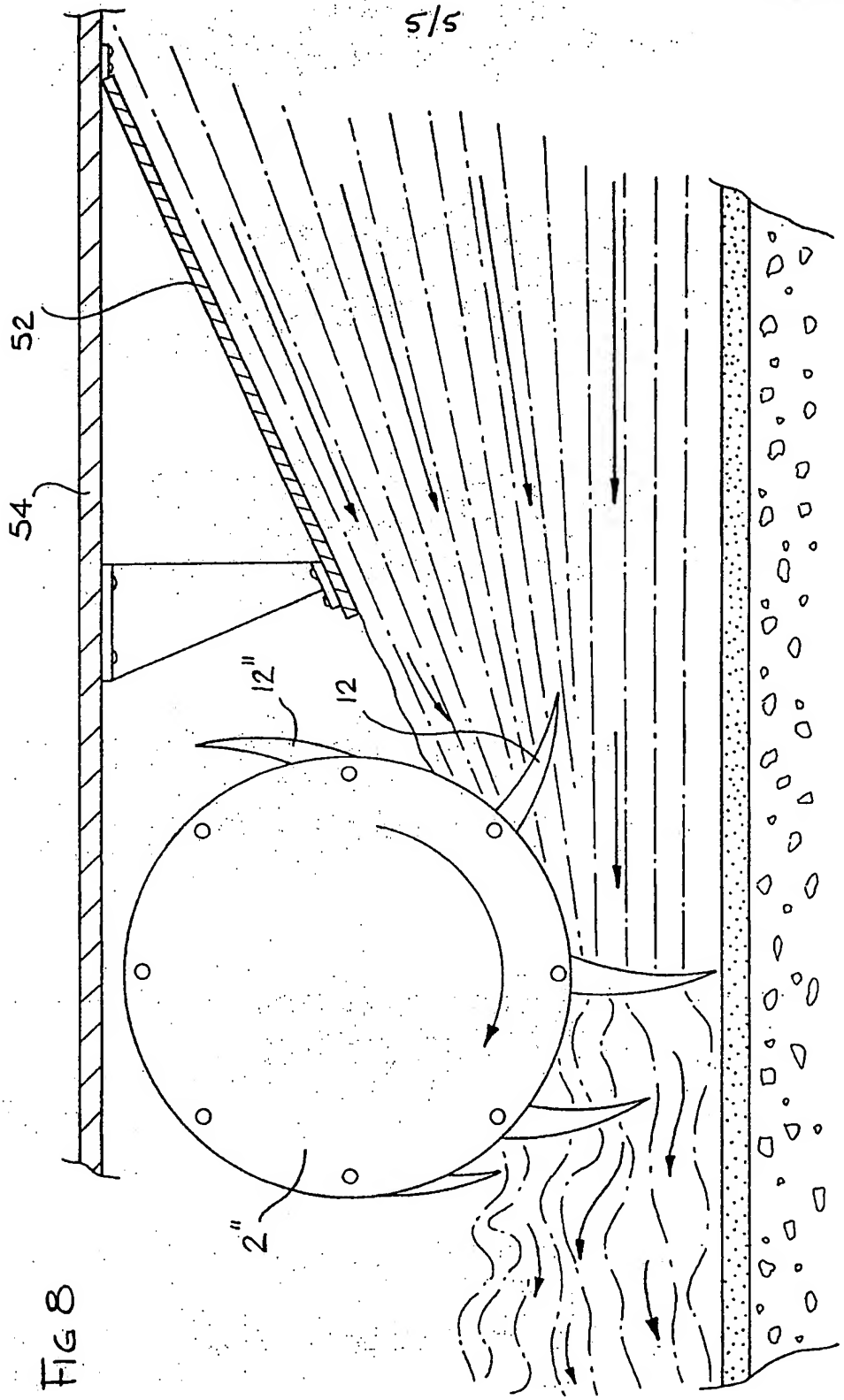


FIG 8

SPECIFICATION

Vaned water wheel

The invention is concerned with improvements in or relating to water-wheels.

The invention provides a water wheel device comprising a drum rotatable about a central axis and provided on a curved circumferential surface thereof with a plurality of vanes arranged parallel to said axis, each of said vanes being movable with respect to the circumferential surface between an operative position in which the vane is extended from the surface in a radial or near-radial manner and an inoperative, retracted, position in which the vane lies at least substantially flush with adjacent vanes.

In the rotational cycle of the drum when immersed in a water flow, those vanes having leading edges facing the direction of flow are forced outwardly of the drum into the operative position. As the drum rotates, so subsequent vanes take their operative position while the preceding vanes return to the retracted condition for the remainder of the 360° cycle. In the retracted position, the vanes present neglible resistance to the water flow. It will be understood that a wheel device according to the invention may operate as an undershot wheel or an overshot wheel.

Advantageously, the vanes may be slat-like members, each pivotally mounted adjacent a longitudinal edge thereof with respect to the drum surface for movement about a hinge line parallel to the drum axis. Preferably, when in the operative position, each vane extends in a plane passing through the drum axis. Conveniently, stop means may be provided to determine the exact operative position.

In examples of water wheels according to the invention, the vanes are provided with curved outer surfaces so that when in their inoperative position, the outer surfaces lie flush to form a substantially smooth cylindrical surface.

It will be understood that whereas in most situations it may be preferable to arrange a water wheel according to the present invention in an orientation in which the drum axis is horizontal and spans at least a part of the width of a waterway i.e. a river or suitable stream, it is equally feasible, where local conditions dictate, for the drum axis to be arranged vertically.

Whereas in deep, fast-flowing waterways it may be preferable for the vanes to lie side by side with the leading edge of one adjacent the trailing edge of the adjacent vane when in the inoperative condition, in many circumstances it may be found advantageous to provide vanes, the leading edge of each overlapping the trailing edge of the adjacent vane. The amount of overlap may be selected according to water volume and flow rates.

Conveniently, the vanes of the water wheel may be mounted on hinge pins received in end plates of the drum itself, or alternatively the end plates may support or be replaced by flywheels. In a waterway location, a water-wheel may be by-passed by a parallel flow-path governed by a suitable sluice gate arrangement. Alternatively, a movable baffle or boom may be provided to divert the waterflow towards the wheel. The effects of extremes of flow rates may thus be at least partially mitigated.

It will be understood that the devices disclosed in this specification will operate efficiently at varying water levels from flood-level to conditions in which, in the case of a horizontally-mounted undershot wheel, only the lowest few vanes are submerged. In many cases, it will be found that up to twice the power is achieved by the wheel device according to the invention compared with conventional fixed vane wheels.

The present wheel device may be arranged as an overshot wheel as required by the selected location by simply reversing the end mountings of the drum. The flow of water then impinges upon the vanes at the upper portion of the circumference of the drum, filling the space between adjacent extended vanes so that the largest possible proportion of the vane surface area is contacted by the water flow. In either case, but especially in the use of an overshot arrangement, the outer lip of the vane may be provided with a ridge arranged on the underside thereof to prevent the edge of the lip lying completely flush. The slightly raised lip edge thus permits the water more readily to lift the vane into its operative position.

Other features and advantages of devices according to the invention will become apparent from the following examples, which will now be described with reference to the drawings. It will be understood that the description is given by way of example only and not by way of limitation.

In the drawings:

Figure 1 shows a diagrammatic side view of a first example of an undershot wheel device according to the invention;

Figure 2 shows a view of the wheel in the direction of arrow II of Figure 1;

Figure 3 is a view on arrows III of Figure 2.

Figure 4 is fragmentary side view of a second example of a wheel device;

Figure 5 is detail of the construction of Figure 4 to an enlarged scale;

Figure 6 is operational layout of a wheel in use;

Figure 7 is detail of the drive arrangement shown in Figure 6, and

Figure 8 is a side view of a water flow deflector in use with a wheel according to the invention.

The arrangement illustrated in Figures 1 and

2 comprises a drum 2 having a closed, hollow interior 4 and mounted fixedly on a shaft 8. The interior of the drum is closed by end plates 10, (Figure 2).

Arranged around the drum so as to lie longitudinally thereof are a plurality (in the present example, twelve) of vanes 12. Each vane has an outer surface 14, a opposite surface 16 and is pivotally mounted at 18 by means of a pivot pin 20 which is anchored at each end in one of the two end plates 10. The vanes are equally spaced around the drum and when in a retracted position lie flush with each other, the curvature of the outer surfaces 14 forming arcs around the circumference of a circle. In their retracted position, the surfaces 16 each confront an inclined surface 22 on the drum.

Provided between the surfaces 22 on the drum are recesses 24 each having a configuration suitable to receive a trailing end portion 26 of a vane 12 when it moves into its extended, operative position. The trailing end portion 26 abuts a radial surface 28 of the recess 24, which surface acts as a stop member, 28.

The drum 2 is positioned in a fast-running stream so as to rotate in a clockwise direction as viewed in Figure 1, the stream flowing from right to left. The drum is set to operate as an "undershot wheel" above a concrete housing 30 set directly on the stream bed 32. The vanes are in their retracted position as they pass over the top of the drum's rotational path and as each vane 12 begins its downward movement (right hand side of drum) it commences to move outwardly under the influence of gravity. As soon as this movement begins to water (arrows A) impinges on the surface 16 and forces the vane into its extended position at the lowest point of the rotation movement so that the full water force impels the drum to enhance its rotary motion. The vanes then return to their inoperative position.

The rotation imparted to the shaft 8 by the drum 2 may be further assisted by the construction of the end plates 10 in the form of flywheels, Figure 3. The flywheels are secured to the drum by bolts 34 and also receive the pivot pins 20 of the vanes. It will be understood that if required, two vaned drums may be arranged end-to-end to permit an increased width of water flow to be utilised.

Figure 4 shows an alternative example of a device according to the invention, in which the vanes 12' are arranged to overlap in a shingled formation. This arrangement may be found particularly advantageous in slower water flow conditions. The amount of overlap may be selected according to conditions, but may for example be from about 25% to, say, 50% of the vane width.

In this example the drum 2' is a hollow cylinder provided with ridges 36 which support stop surfaces 38, equivalent in operation to the surfaces 28 of Figures 1 and 2. Figure 5 shows a fragmentary view of this arrangement.

Figure 6 illustrates the device of Figures 1 and 2 situated in an operating zone in which the housing 30 has been constructed to include a sluice gate 42 operable to control a by-pass flow of water through a channel 44. The normal level of water is indicated at 46. An inspection chamber 48 is provided within the housing. The shaft 8 is connected through a system of mitre gear wheels 48 (Figure 7) to a generator or a pump in a housing 50.

Not illustrated, but advantageously installed upstream of the device, is a trap arrangement to divert or retain debris, logs or the like which may damage the vanes of the wheel. A preferred arrangement where appropriate would include a fish ladder to accommodate migrating salmon, eels and other fish.

Figure 8 shows a modification in which a deflector blade 52 or baffle is arranged across the width of the drum 2" and slightly upstream thereof. The blade 52 is supported on an overhead portion 54 of the framework structure and may be angularly adjusted to control the degree of deflection desirable to ensure the maximum force of water impinging on the vanes 12".

Various modifications may be made within the scope of the invention as defined in the following claims.

CLAIMS

1. A water wheel device comprising a drum rotatable about a central axis and provided on a curved circumferential surface thereof with a plurality of vanes arranged parallel to said axis, each of said vanes being movable with respect to the circumferential surface between an operative position in which the vane is extended from the surface in a radial or near-radial manner and an inoperative, retracted, position in which the vane lies at least substantially flush with adjacent vanes.

2. A device as claimed in claim 1 wherein in their retracted position, the vanes present negligible resistance to water flow.

3. A device as claimed in claim 2, wherein the outer surface of each vane is curved in a part-cylindical convex contour, so that when in said retracted position the outer surfaces lie flush to form a substantially smoother cylindrical surface.

4. A device as claimed in any one of the preceding claims wherein the inner surfaces of the vanes are curved in a concave contour.

5. A device as claimed in any one of the preceding claims wherein each vane is in the form of a slat pivotally mounted adjacent a longitudinal edge thereof with respect to the drum surface for movement about a hinge line parallel to the drum axis.

6. A device as claimed in claim 5, wherein, when in the operative position, each vane ex-

tends in a plane passing through the drum axis.

7. A device as claimed in any one of the preceding claims wherein there are provided stop means to determine the exact operative position of each vane.

8. A device as claimed in any one of the preceding claims, wherein the drum axis is horizontal.

9. A device as claimed in claim 8, wherein the drum is arranged for use as an undershot wheel.

10. A device as claimed in claim 8, wherein the drum is arranged for use as an overshot wheel.

11. A device as claimed in any one of claims 1 to 7, wherein the drum axis is vertical.

12. A device as claimed in any one of the preceding claims wherein the vanes are arranged when in their inoperative retracted position to lie in an overlapping arrangement.

13. A device as claimed in claim 12 wherein the vanes overlap by upto 50% of the width thereof.

14. A device as claimed in any one of the preceding claims wherein the drum is provided with end walls or plates in the form of flywheels.

15. A device as claimed in any one of the preceding claims wherein there are provided water flow deflecting devices to enhance the flow of water which, in use, impinges on the vanes.

16. A device as claimed in any one of the preceding claims wherein there is provided an upstream trap arrangement to divert or retain debris or other matter.

17. A water wheel device, constructed and arranged substantially as hereinbefore described with reference to and as shown in the drawings.

Printed for Her Majesty's Stationery Office
by Burgess & Son (Abingdon) Ltd, Dd 8991685, 1987.
Published at The Patent Office, 25 Southampton Buildings,
London, WC2A 1AY, from which copies may be obtained.